SCIENTIFIC OBJECTIVES AND ENGINEERING CONSTRAINTS OF FUTURE TITAN LANDING SITES

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The process of identifying potential landing sites on Titan is based on the analyses of science cases, the definition of candidate sites, and engineering considerations. Regions for in-situ observations are the atmosphere, the surface, including both solid and liquid surfaces, and the subsurface. The most critical engineering constraints are the atmospheric density and composition, temperature, surface hardness, roughness, inclination, sub-surface hardness, mechanical uniformity, composition, layering depths, and wind and seismic levels. The most promising sites are wet polar regions or dry equatorial regions because of their high compositional diversity and the mobility of material.

North Polar Lakes above >72°N (200km circular delivery error can be accommodated in Ligeia Mare; Kraken Mare can probably accommodate ~400km circular delivery zone). These areas address the most exiting science goals of the methanological cycle and the productions of organics. In particular, beach regions, with close contact to liquids, are a primary target because: (1) The chemical and isotopic composition of lake liquids can be determined over time to constrain diurnal and seasonal variations in atmospheric photochemistry and precipitation and to detect less abundant atmospheric species as they would become more concentrated in the lake. (2) An extraordinarily important goal of any return to Titan would be to constrain its climatic history, and one of the best ways to do that would be to analyze the chemical and isotopic composition of lake sediments combined with age dating using ^{14}C techniques, among others, This will allow to determine both long-term (climatic), versus short term (seasonal) changes. (3) An analysis of sediments suspended in the lake will also identify both the sedimentation characteristics of atmospheric particles, as well as the role of wind and fluvial erosion processes on Titan. However, the engineering requirements for such zones are hard to meet.

Equatorial Dunefields (e.g. Belet can be hit by a 15x40° ellipse (600x1600km) at 255°W 5°S (center of ellipse)). Dune areas best fits engineering requirements while providing still a wide range of science goals due to the organic characteristics of the dune material and its close relationship to atmospheric processes. The macromolecular refractory organics constituting the nucleus of Titan's aerosol may, in the presence of water (ice), chemically evolve and produce a large variety of organics, including amino acids that might be important to understand Titan's potential for habitable environments. Subsurface sounding, using sonar or radar techniques depending on the platform, will also provide key constraints on the sediment layering, and hence on Titan's climatic history. In case of solid landing, radio tracking and seismic investigations will also provide information on Titan's interior and tectonic activity.